MEMORANDUM

To: EPA Region 10 Portland Harbor RI/FS File

From: Portland Harbor RI/FS Team

Date: May 2016

Subject: MNR Evaluation - Fish Contaminant Concentrations
Portland Harbor Superfund Site
RAC Contract Number EP-W-05-049

MNR EVALUATION - FISH CONTAMINANT CONCENTRATIONS

Fish tissue samples were collected as part of the Portland Harbor remedial investigation (2002 and 2007) and in 2011 and 2012 to update contaminant concentrations in fish and assist in developing natural recovery trends. The most robust fish tissue data set exists for smallmouth bass and PCBs: it was the only fish species collected during all fish tissue collection efforts, and PCBs were the only COCs analyzed for in samples collected in 2011 and 2012. There were some methodological inconsistencies between the surveys. For example, in 2002 individual fish were collected and composited by river mile from both sides of the river. In 2007, individual fish were collected and composited by river mile and by side of the river, fish collected in 2011 and 2012 were analyzed as individuals. In 2011, the analytical laboratory contracted by EPA incorrectly prepared 75 percent of the samples as skin-off fillets, discarding the remainder of the carcass instead of processing the whole fish. Thus, results from the 2011 sampling effort are limited.

PCB concentrations in whole body fish from the 2007 through 2012 data were evaluated simultaneously, with trend estimates specific to each side of river and river-mile. While sampling in 2007 and 2012 is spatially extensive, 2011 sampling is sparse, so most river segments are supported by just 2 time steps – 2007 and 2012.

This simultaneous analysis was based on an analysis of a covariance model including discrete terms representing average concentration per river mile and east-west groupings with a continuous term representing year, and the interaction between year and sampling group. Analysis of covariance models are used to account for two or more variables, so that each effect is estimated while controlling for the other variables in the model. In this case, it is recognized that the mean concentration and temporal decay rates may vary by spatial location as represented by sampling groups. By accounting for between sampling-group variability, the power to detect temporal trends is increased. The model is of the form:

$$\log\left(C_f/F_l\right) = \sum_i \phi_i \times \mu_i + a \times year + \sum_i b_i \times \phi_i \times year$$

where μ_i represents the sampling location mean (i.e. river mile east or west) and ϕ_i is a binary variable set to 1.0 for the i^{th} group and 0.0 otherwise. From this model, the exponential decay rate for the i^{th} group is given by the sum of the overall average decay rate (a) and the difference in decay rates for the i^{th} group (b_i) so each group has a distinct estimated decay rate ($a+b_i$). Regression parameters were estimated by least squares and the estimated model amounts to fitting a distinct exponential decay model for each group, but with the advantage of using all of the data simultaneously, providing greater statistical power.

The decay rates resulting from this analysis, including error bars representing 95 percent confidence intervals on the estimated decay rates, are presented in Figure 1. This plot provides the estimated MNR recovery rate and confidence intervals which should be compared with zero to determine if an estimated rate differs significantly from zero (i.e. no change) at the 5 percent level of statistical significance. Confidence intervals that exclude zero indicate that the estimated rate is statistically significantly different from zero at the 5 percent level of significance. Conversely intervals that capture zero indicate that estimated decay rates are not different from zero. These results are equivalent to testing the null hypothesis of no change at a 5 percent level of significance, but provide a more complete summary by showing both the result of the test of hypothesis visually, but also providing the additional information needed to understand why the hypothesis was or was not rejected. For example, when an estimate is not statistically different from zero, it could be because the estimate itself is close to zero and yet relatively narrow intervals still capture zero, or the estimated coefficient could be very different form zero, but with a very wide confidence interval. The former situation would imply that the decay rate is small and that it is just close to zero with strong level of confidence, whereas the latter situation would indicate that the data are too sparse to precisely estimate the decay rate.

Overall, the small sample size, limited number of time points, and inconsistency in sampling methodology preclude a meaningful, statistically-valid determination of trend. The sampling design, sample preparation and chemical analysis methods used in 2012 should be considered as a template to be repeated for subsequent surveys.

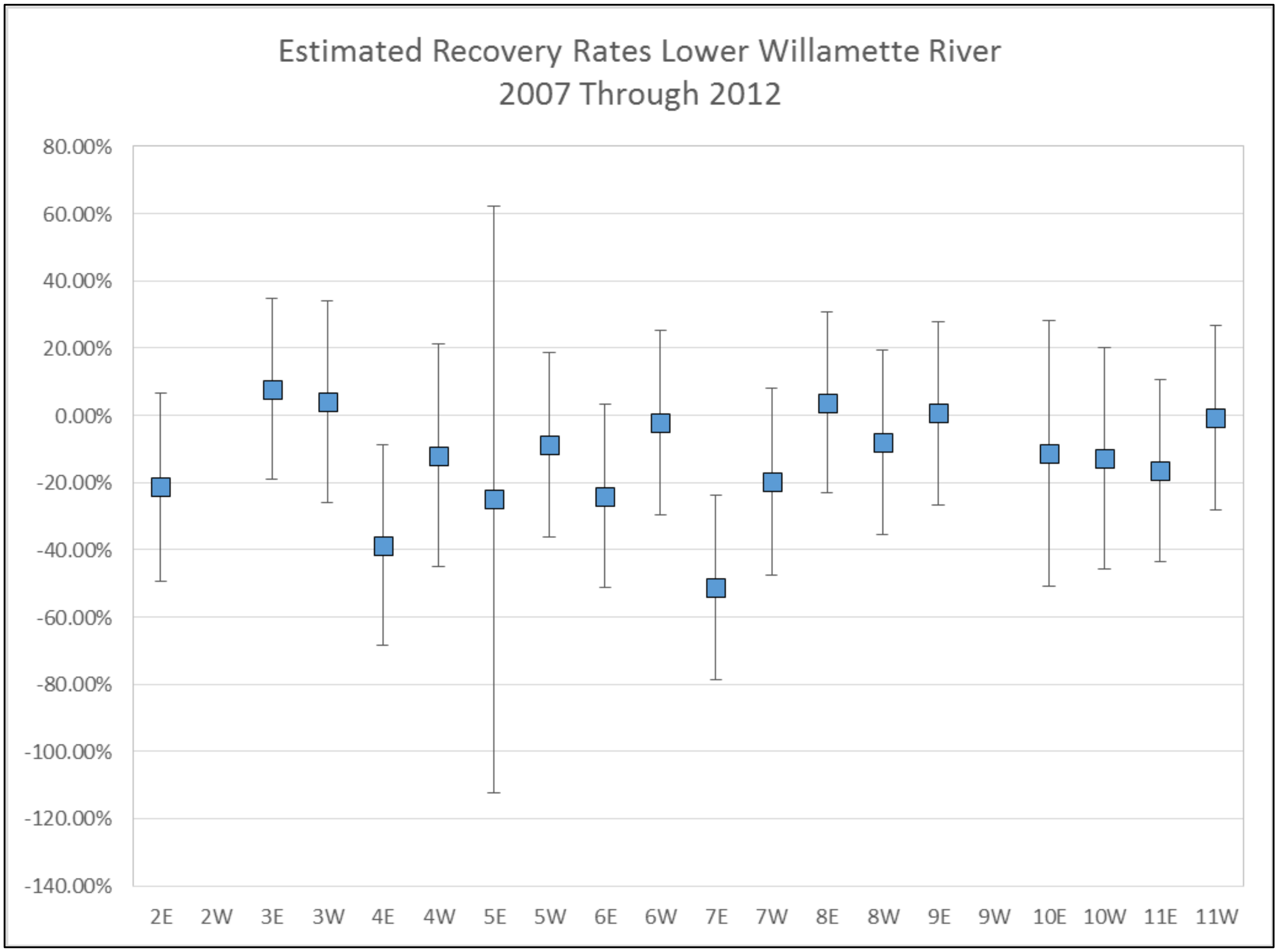

Figure 1. Annualized Decay Rate of Fish Tissue Concentrations Grouped by River Mile and Side of River.

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